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ABSTRACT

Highlights of the findings of a 1980 National Science Foundation supported survey of full-time faculty in the 156 doctorate-granting institutions with the largest Federal research and development funding in the fiscal year 1977 are reported. The role of recent doctorates, faculty with tenure, research activities, and faculty turnover are discussed and summarized in one chart and three tables. (DS)

SCIENCE RESOURCES STUDIES HIGHLIGHTS

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SCIENCE AND ENGINEERING FACULTY WITH RECENT DOCTORATES FELL TO ONE-FIFTH OF TOTAL IN 1980

These Highlights report the findings of a 1980 survey supported by the National Science Foundation (NSF). "Study of Research Participation and Other Characteristics of Recent Science and Engineering Faculty." The survey describes full-time faculty in the 156 doctorate-granting institutions with the largest Federal R&D funding in fiscal year 1977. In these universities, survey questionnaires were sent to about 1,900 departments that offered science and engineering (S/E) doctorates. Responses from the 79 percent of surveyed departments that returned questionnaires were weighted for nonresponse to represent all 1,900 departments.

Highlights

- The proportion of recent doctorates—those holding their degrees for seven years or less—on the full-time faculty of S/E departments in Ph.D.-granting institutions was 21 percent in 1980—down from 28 percent in 1974 and 39 percent in 1968.
- Between 1974 and 1980, this proportion fell in 14 of 15 S/E fields. The largest drop was in mathematics where the share fell from 35 percent to 22 percent. Chemical engineering was the only field that showed an increase (from 21 percent to 23 percent).
- Correspondingly, the fraction of full-time faculty with tenure rose in 12 of the 15 fields with an average gain of about 5 percentage points. Only chemical engineering had a significantly lower tenure proportion in 1980 than in 1974. The greatest 1980 concentration of tenured faculty was in physics, 83 percent, whereas the lowest was in computer science, 59 percent.
- About 5 percent of 1978-79 full-time faculty changed employers or left the active labor force before the beginning of the next academic year. Voluntary resignations to accept other academic positions accounted for one-third of the departures.
- Overall, switches to nonacademic employment accounted for one-fifth of departures. Such intersectoral mobility was most extensive in engineering (28 percent of exits) and least in social sciences (13 percent).
- In 1979-80 approximately 7 percent of full-time faculty had been newly appointed to their departments. As a group, departments filled the majority of their 1979-80 faculty needs by recruiting from the ranks of graduate students and postdoctorates. Experienced faculty from other institutions provided another third of appointees. One-fifth of new faculty in the engineering fields came from industry.

The Role of Recent Doctorates

Many observers believe that recent doctoral faculty play a key role in advances in academic research, although it has not been demonstrated that younger researchers are on average more productive than their senior colleagues.[1] [2] Even though the issue of relative productivity is still an active research topic, there seems little dispute that younger faculty make important contributions.

NSF has conducted or supported a series of surveys which have traced a steady decline in the proportion of S/E faculty who have held their doctorates seven years or less. Recent doctorates fell as a share of total full-time S/E faculty from 39 percent in 1968 to 28 percent in 1974 and to 21 percent in 1980. The 1968 share reflects the massive inflow of new faculty in response to the rapid increase in college enrollments during the sixties. Of the 15 fields surveyed in both 1974 and 1980, 14 recorded a drop; only chemical engineering showed a small increase in the percentage of recent faculty (chart 1). At the level of the six broad S/E fields in 1980, the physical sciences had the lowest recent doctorate share (14 percent) and the social sciences the highest (29 percent).

By 1980 the percentage representation of younger faculty had declined to a level well below that believed optimal by department heads (table 1). The overall median desired value of 30 percent contrasts sharply to the actual 22 percent of doctoral faculty holding their degrees seven years or less. (Note that these percentages apply to only doctoral faculty whereas percentages in the preceding paragraph apply to total faculty.) In no broad field was the "optimal" percentage reached. Social scientists recorded the smallest gap between desired and actual levels (33 percent vs 30 percent). The

[1] For a discussion of the contributions of younger faculty see National Academy of Sciences, *Research Excellence Through the Year 2000* (Washington, D.C., 1979).

[2] S. Cole, "Age and Scientific Performance," *American Journal of Sociology*, 1979.

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overall "optimum" of 30 percent seems to be stable both over time and across surveys. The same average for the desired level of representation was obtained in a 1975 survey supported by NSF.[3]

Not surprisingly, recent doctorates were concentrated in entry-level faculty ranks. Only 2 percent were full professors as compared to 15 percent who were associate professors and 78 percent who were assistant professors. An additional 3 percent held the rank of instructor, a seldom used classification in universities. In contrast, two-thirds of senior faculty had attained full professorships.

Table 1. Difference between actual and desired percentages of recent full-time doctoral faculty: 1988

Field	Recent doctorates as percent of total doctoral faculty (a)	Percentage of recent doctorates desired by department heads* (b)	Difference between actual and desired percentage (c)=(a)-(b)
Total	22	30	-8
Engineering	22	30	-8
Physical Sciences	15	25	-10
Biological sciences	20	27	-7
Mathematical sciences	26	30	-4
Social sciences	30	33	-3
Psychology	27	34	-7

*Median value of responses

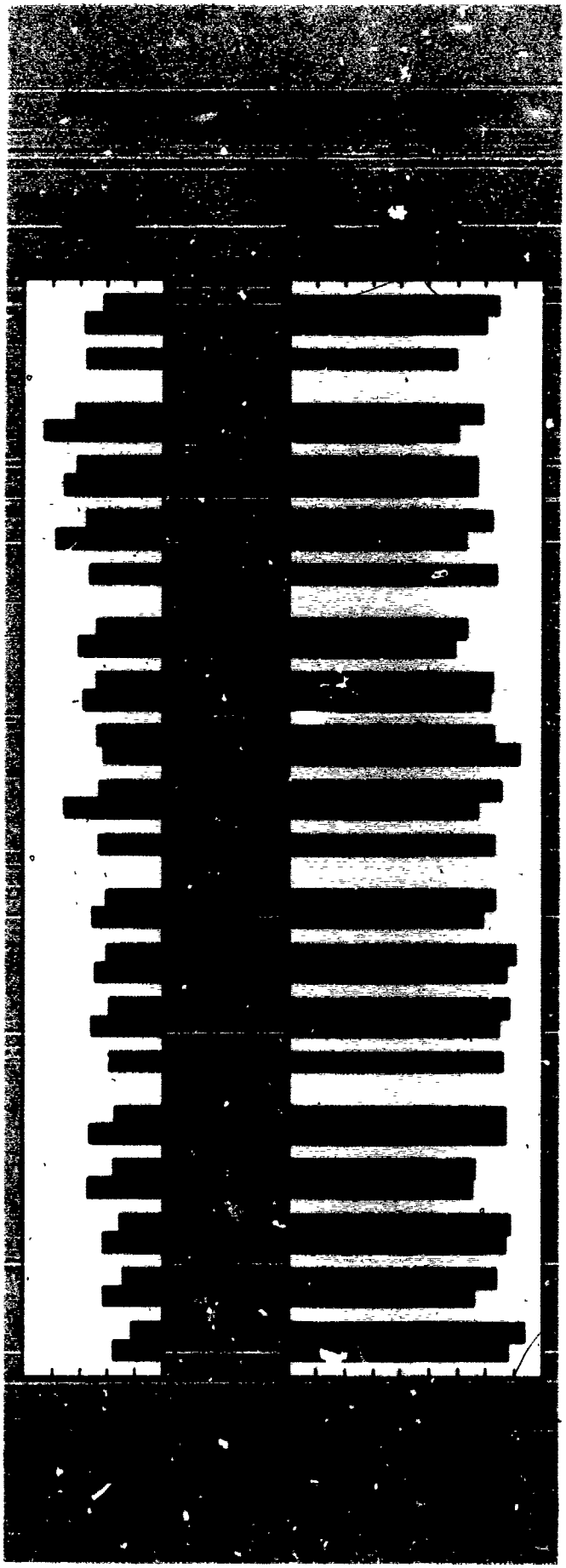
SOURCE National Science Foundation

Faculty with Tenure

The survey found that not only had the representation of recent doctorates declined but also that a rise in the proportion of faculty with tenure had reduced the number of openings that would be available in the future.[4] The percentage of faculty with tenure rose from 70 in 1974 to 74 in 1980. This proportion increased in 12 of the 15 fields surveyed in both years. Only chemical engineering had a significantly lower tenure proportion in 1980 than in 1974. Of the six broad fields, the physical sciences had the highest 1980 level of tenured faculty (81 percent); other broad fields ranged from 70 percent to 75 percent.

Research Activity

If younger faculty make important contributions through their research, as suggested earlier in this *Highlights*, their



[3]American Council on Education. *Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980*. Higher Education Panel Report Number 30 (Washington, D.C.)

[4]See National Science Foundation, Science Resources Studies Highlights, "Tenure Practices in Universities and 4-Year Colleges Affect Faculty Turnover" (NSF 81-300), February 23, 1981 (Washington, D.C.)

contributions are determined in large part by their success in obtaining support from research sponsors—particularly the Federal Government. (According to another NSF survey, three-fourths of S/E faculty time spent in research in universities is sponsored and separately budgeted.)[5] Both recent and senior doctoral faculty averaged almost one research proposal per person in academic year 1978-79. Engineers and physical scientists submitted proportionately the most proposals—about 1.3 and 1.2 per faculty member, respectively; and mathematical and social scientists the fewest—about one proposal for each two persons. In each broad field, senior faculty had received approval for a higher percentage of their proposals by the time of the survey, spring 1980, than had recent doctorate faculty—66 percent versus 58 percent for all fields combined.[6] The lowest approval proportion was for younger engineering faculty (48 percent) and the highest was for more senior mathematical scientists (71 percent).

Both the 1974 and 1980 surveys asked for an evaluation of the appropriateness of the distribution of research support between younger and senior faculty which had resulted from past funding patterns. Department heads in the surveyed S/E fields as a group were less likely in 1980 than six years earlier to believe that younger faculty were disadvantaged. Almost two-thirds of responding heads in 1980 in all fields combined believed that the existing split in research support was appropriate. Those expressing a contrary opinion (about one-fourth of the respondents) were about equally divided as to which group should get a larger share of the funding, with a slightly larger percentage supporting younger faculty. The greatest dissatisfaction with the existing split in support was in the mathematical sciences where 27 percent of department heads believed younger faculty received too small a share as compared to only 6 percent who felt that senior faculty received less than was appropriate.

Faculty Turnover

The flow of recent doctorates into academic depends, first, upon the number of positions which become available each year through replacement of departed faculty or growth in department size and, second, upon the years of experience of those appointed to fill these openings. About 5 percent of S/E faculty, or 2,200 in the surveyed universities, left the institutions at which they were employed prior to the 1979/80 academic year. These departures were more than matched by the approximately 2,800 appointments for 1979/80, thus indicating about 2 percent aggregate growth in faculty positions. As explained below, about four-tenths of these appointees were experienced scientists and engineers coming from other full-time jobs (table 2).

The broad fields varied little in their attrition rates as summarized in the following tabulation, and each experienced at least some staff growth.

	All S/E fields	Engineering	Physical sciences	Biological sciences	Mathematical and computer sciences	Social sciences	Psychology
Number of separations per 100 full-time faculty ...	5	6	4	5	6	6	5

The relative uniformity of these growth patterns by field does not correspond with apparent changes in the distribution of instructional burden among S/E disciplines. For example, social sciences baccalaureates nationwide dropped about 20 percent between 1973/74 and 1978/79 compared to over 37 percent growth in engineering bachelor's degrees between 1975/76 and 1978/79.

Overall, about one-third of the separations were voluntary transfers of experienced faculty among academic institutions (table 3).[7] Intra-academic mobility was most marked in psychology and the mathematical and social sciences where it accounted for two-fifths of departures as compared to only one-fifth in the physical sciences.

Survey results support anecdotal information that academia is a small net donor of experienced scientists and engineers to other sectors. After the 1978/79 academic year, about 1 percent of university S/E faculty voluntarily resigned to take nonacademic jobs whereas only one-third as many left industry for academic with an unknown, but probably much smaller number coming from government and nonprofit institutions.[8] The highest level of exchange be-

[5] *Ibid.*, "University S/E Faculty Spend One-Third of Professional Time in Research" (NSF 81-317), August 31, 1981 (Washington, D.C.)

[6] Because younger faculty had a slightly larger fraction of proposals that had not yet been decided upon, this gap might fall by perhaps 3 percentage points if the disposition of all proposals were known.

[7] This proportion assumes that none of the faculty appointments for 1979/80 had earlier been denied tenure at another institution.

[8] The survey question on origins of new appointees combined those from these two sectors with those whose previous status was "other or unknown."

Table 2. Professional status prior to full-time faculty appointment: 1979/80

(Percent)

Field	Full-time graduate student	Post-doctorate	Full-time faculty or staff	Full-time industrial employee	Other or unknown
All fields	34	23	33	6	5
Engineering	41	10	26	17	6
Physical sciences ..	18	42	30	5	5
Biological sciences	11	51	34	1	3
Mathematical sciences	43	10	36	3	9
Social sciences	51	5	36	3	4
Psychology	39	15	39	1	7

SOURCE: National Science Foundation

Table 3. Reasons for departures of full-time faculty leaving 1978/79 positions

(Percent)

Field	Voluntary resignation					Involuntary resignation	
	Retirement	Illness or death	Another academic position	Non-academic position	Other	Failure to receive tenure	Other
All fields	20	4	34	20	6	12	5
Engineering	23	5	32	28	6	5	1
Physical sciences	27	6	21	23	8	13	3
Biological sciences	23	4	32	14	6	16	6
Mathematical sciences	11	5	39	20	5	12	9
Social sciences	19	3	39	13	6	14	7
Psychology	12	2	42	21	3	17	3

SOURCE National Science Foundation

tween academic and other sectors was in engineering, the only broad field in which industry was a major source of appointees. Although such sectoral mobility reflects the often close correspondence between industrial and academic engineering activities, these transfers amounted to only about 1 percent to 2 percent of engineering faculty.[9]

The remainder of faculty separations were for causes other than voluntary changing of employers. Retirement, the most frequent of these other causes, accounted for about one-fifth of those leaving in all S/E fields. These exits equalled about 1 percent of total faculty. This comparatively lower level results both from the midcareer separation of some faculty and, more importantly, the relatively small numbers who are near retirement age.[10] Recent Federal law will raise the mandatory retirement age in universities and colleges to 70, effective in 1982, suggesting that retirements may continue to be fairly limited for several years. Ultimately, delayed retirements would tend to increase the fairly small attribution caused by death or illness.

Involuntary separations due to failure to receive tenure caused one in eight departures. The much lower level in engineering (only one in twenty exists) presumably is caused by the difficulty colleges of engineering have had in filling faculty slots and the resulting eased competition for tenure. Other involuntary separations resulting from factors such as forced reductions in department size as well as disciplinary actions caused another 1 in 20 departures. This residual category of involuntary resignations was most significant in the mathematical sciences where it accounted for 1 in 11 exits.

As shown in table 2, about four-tenths of those joining S/E departments in 1979/80 had held full-time jobs elsewhere the previous year. The remaining appointees had been full-time graduate students or postdoctorates and hence could be assumed to have received their degrees within the preceding seven years.[11] (This excludes the small number of new faculty whose prior status was "other or unknown.") Thus in 1979/80, newly appointed recent doctorates constituted about 4 percent of total full-time faculty (or about three-fifths of the 7 percent of faculty who were newly appointed). If this percentage were to hold in the future, recent doctorates would ultimately represent about 25 percent of university S/E faculty.[12]

[9] These figures are consistent with the findings of Higher Education Panel Survey 52 that 2 percent of experienced engineering faculty voluntarily left academia for industry after 1979/80. American Council on Education, *Recruitment and Retention of Full-Time Engineering Faculty, Fall 1980*, Higher Education Panel Report No. 52 (Washington, D.C.)

[10] The survey found that only 2 percent of S/E faculty were 65 to 69 years old and only 6 percent were in the 60 to 64 bracket.

[11] This, of course, assumes all new university S/E faculty have completed their doctorates when, in fact, some are in the final stages of their dissertation.

[12] This rough calculation assumes that new appointees who are recent doctorates have spent an average of one year as a postdoctorate so that they have six years remaining as recent doctorates. Thus, 4 percent doctorates hired per year times six years equals 24 percent.

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